CLAIMS

What is claimed is:

1. A heat exchange system for stabilizing gas temperature in a pulsed gas discharge laser, the laser including a discharge chamber having at least two electrodes for energizing a laser gas in the discharge chamber to generate optical pulses according to a pulse pattern, the heat exchange system comprising:

a flow control valve for controlling an amount of fluid flowing through the discharge chamber;

a system controller for determining an amount of energy dissipation for a period of the pulse pattern and generating a dissipation signal in response thereto; and

a temperature regulation controller in communication with the flow control valve and capable of receiving the dissipation signal, the temperature regulation controller capable of adjusting the amount of fluid flowing through the flow control valve based, at least in part, on the amount of energy dissipation conveyed by the dissipation signal.

2. A heat exchange system according to claim 1, further comprising:

a fluid source for providing the fluid at a source temperature.

3. A heat exchange system according to claim 1, further comprising:

a first temperature sensor for measuring the source temperature and providing a first temperature signal to the temperature regulation controller, the temperature regulation controller capable of adjusting the amount of fluid flowing through the flow control valve based, at least in part, on the first temperature signal.

4. A heat exchange system according to claim 1, further comprising:

a second temperature sensor at least partially within the discharge chamber for measuring a laser gas temperature and providing a second temperature signal to the temperature regulation controller, the temperature regulation controller capable of

adjusting the amount of fluid flowing through the flow control valve based, at least in part, on the second temperature signal.

5. A heat exchange system according to claim 1, further comprising:

a third temperature sensor outside the discharge chamber for measuring a laser tube temperature, the laser tube containing the discharge chamber, and providing a third temperature signal to the temperature regulation controller, the temperature regulation controller operable to adjust the amount of fluid flowing through the flow control valve based, at least in part, on the third temperature signal.

6. A heat exchange system according to claim 1, further comprising:

tubing at least partially within the discharge chamber for contacting the gas mixture and containing the fluid flowing through the discharge chamber.

7. A heat exchange system according to claim 1, wherein:

the system controller is further capable of selecting the period for determining the energy dissipation.

8. A heat exchange system according to claim 1, further comprising:

a laser tube containing the discharge chamber; and

an active heating element in contact with the laser tube and operable to heat the laser tube.

9. A heat exchange system according to claim 8, wherein:

the active heating element surrounds the laser tube in order to substantially uniformly heat the laser tube.

10. A heat exchange system according to claim 8, wherein:

the active heating element is a foil heating pad capable of substantially covering an exterior surface of the laser tube.

11. A heat exchange system according to claim 8, wherein:

the temperature regulation controller is further in communication with the active heating element, the temperature regulation controller capable of adjusting the amount of heat applied to the laser tube by the active heating element based, at least in part, on the amount of energy dissipation conveyed by the dissipation signal.

12. A method for stabilizing gas temperature in a pulsed gas discharge laser, comprising:

directing a flow of cooling fluid through tubing disposed at least partially within a discharge chamber of the laser such that the tubing contacts a gas mixture in the discharge chamber;

determining an amount of energy dissipation over a period of a pulse pattern of the laser in order to determine an amount of energy dissipation in the discharge chamber; and

adjusting an amount of cooling fluid flowing through the tubing based, at least in part, on the amount of energy dissipation over that period of the pulse pattern.

13. A method according to claim 12, further comprising:

measuring a temperature of the cooling fluid; and

adjusting the amount of cooling fluid flowing through the tubing based, at least in part, on the temperature of the cooling fluid.

14. A method according to claim 12, further comprising:

measuring the gas temperature in a laser tube of the laser; and

adjusting the amount of cooling fluid flowing through the tubing based, at least in part, on the gas temperature.

15. A method according to claim 12, further comprising:

measuring the tube temperature of a laser tube of the laser; and

adjusting the amount of cooling fluid flowing through the tubing based, at least in part, on the tube temperature.

16. A method according to claim 12, further comprising:

adjusting an amount of heat added to a laser tube of the laser by an active heating element based, at least in part, on the amount of energy dissipation over that period of the pulse pattern.

17. A method according to claim 12, further comprising:

heating a laser tube of the laser using an active heating element substantially surrounding the laser tube.

18. A method according to claim 12, further comprising:

selecting the period over which the amount of energy dissipation is determined.

19. A method according to claim 12, further comprising:

selecting the period over which the amount of energy dissipation is determined, the length of the period being shorter than a response time of a temperature sensor used to measure the temperature of the gas mixture.

20. A temperature regulation system for stabilizing gas temperature in a pulsed gas discharge laser, the laser including a laser tube having at least two electrodes for energizing a laser gas in the laser tube to generate optical pulses according to a pulse pattern, the temperature regulation system comprising:

an active heating element substantially surrounding the laser tube and capable of heating a body of the laser tube; and

a temperature sensor capable of measuring a temperature of the laser tube body and generating a signal in response thereto, the active heating element capable of receiving the signal adjusting the heating of the body based, at least in part, on the temperature of the laser tube.

21. A system according to claim 20, further comprising:

a system controller coupled with the temperature sensor, the system controller using information about an energy dissipation of a period of the pulse pattern, and the temperature of the laser tube, to generate and send a control signal to the active heating element to adjust the heating of the laser tube.

22. A temperature regulation system according to claim 21, further comprising:

a gas temperature sensor at least partially within the laser tube for measuring the gas temperature and providing a gas temperature signal to the system controller to be used in generating the control signal.